

REMARKS

This paper responds to the Office Action mailed on July 5, 2006 and the Advisory Action mailed on October 2, 2006.

Claims 7, 13, 16, 19, 21, 22, 28 and 31 are amended, no claims are canceled, and no claims are added; as a result, claims 1-3, 7-9 and 13-41 are now pending in this application. Applicants incorporate all prior responses by reference in connection with the present application in order to preserve all issues for appeal.

Applicant further informs the examiner that another pending application (serial no. 11/456537) that is in the same family, i.e., common priority, has published as 20060246655A1.

§103 Rejection of the Claims

Claims 7-8, 13, 16, 18-20, 25, 27-28, 31-32 and 34-41 were rejected under 35 U.S.C. § 103(a) as being unpatentable over U.S. Patent No. 5,688,724 to Yoon *et al.* (hereinafter, “the Yoon reference”) in view of U.S. Patent No. 6,828,191 to Wurster *et al.* (hereinafter, “the Wurster reference”). Claims 1-3, 9, 14, 17, 21-24, 26, 29-30 and 33 were also rejected under 35 U.S.C. § 103(a) as being unpatentable over the Yoon reference in view of the Wurster reference, as applied to claims 7-8, 13, 16, 18-20, 25, 27-28, 31-32 and 34-41 above and further in view of U.S. Patent No. 6,156,600 to Chao *et al.* (hereinafter, “the Chao reference”) and U.S. Patent No. 5,712,208 to Tseng (hereinafter, “the Tseng reference”). Applicant disagrees with the stated grounds of rejection and desires to further clarify various distinctions of the present invention over the cited art. Reconsideration of the present application is therefore requested in light of the present amendment and following remarks.

Although the disclosed embodiments of the invention may be discussed in comparison to the prior art, it is understood that any discussion of the disclosed embodiments, as well as any discussion of the differences between the disclosed embodiments of the present invention and the prior art do not define the scope or interpretation of any of the claims. Instead, such discussed differences, if presented, are offered solely to help the Examiner appreciate important claim distinctions.

The Examiner has cited the Yoon reference for disclosing a method of forming a coupling dielectric structure for a memory cell. With reference to Figures 3-6 in the Yoon reference, a tantalum pentoxide layer 14 is formed using a chemical vapor deposition (CVD) process. (Col. 4, lines 20-22). Subsequent to the deposition of the tantalum pentoxide layer 14, the layer 14 is annealed and oxidized, as disclosed at col. 4, lines 35-36. The disclosed annealing and oxidation processes occur in a *conventional furnace* using oxygen, ozone or an inert gas. (Col. 4, line 37-38). The Examiner, however, appears to assert that the disclosed annealing and oxidation process using a conventional furnace is not distinguishable from a rapid thermal processing (RTP) oxidation of the tantalum pentoxide layer, as disclosed in the present application. Applicants respectfully disagree.

As understood by those of ordinary skill, RTP provides rapid thermal processing of materials. For example, rapid thermal heating may be performed within a suitable chamber using graphite heating sources, microwave sources, plasma arc sources and tungsten halogen heat sources, among others, that are located within the chamber. Accordingly, radiation emitted from any of the foregoing sources may be coupled into the material within the chamber so that the material is elevated to the desired temperature much faster than would be obtainable using a conventional furnace.

The Examiner also cites the Wurster reference for disclosing a gate oxide layer that is formed in an oxidizing atmosphere having oxygen or water, and alleges that the disclosed gate oxide layer teaches the wetgate oxide of the various disclosed embodiments of the present invention. Applicants respectfully disagree, and further note that the Wurster reference fails to disclose rapid thermal processing (RTP) of tantalum pentoxide in order to oxidize the tantalum pentoxide.

The Examiner has also cited the Chao reference for disclosing depositing a tantalum oxide layer using low pressure chemical vapor deposition (LPCVD) using an organic metal precursor. Specifically, Chao discloses using tetra-acetyl-ethyl-tantalum-oxide (TATEO) precursor in the LPCVD process. The Examiner has also cited Chao for disclosing RTP annealing of a tantalum oxide layer in a dinitrogen oxide layer. The Applicants note, however, that the Chao reference explicitly teaches forming tantalum oxide nitride layers that abut the tantalum oxide layer in order to *avoid* the formation of a silicon oxide layer adjacent to the

tantalum oxide layer. The Examiner is directed to col. 3, lines 31-45 for this disclosure. Accordingly, Applicants maintain that the annealing process taught by Chao is incompatible with the formation of a silicon oxide layer, and therefore *teaches away* from the presently disclosed embodiments, which include a silicon oxide layer formed *adjacent* to the tantalum oxide layer. Finally, the Examiner has cited the Tseng reference for disclosing the formation of a substrate that includes silicon, gallium arsenide, silicon-on-sapphire, germanium and amorphous silicon. Applicants note that the Tseng reference fails to remedy the teaching missing from the Yoon, Wurster and Chao references.

Turning now to the claims, distinguishing differences between the specific claim language and the cited references will now be discussed. Claim 1, presently recites in pertinent part: “A method of forming a coupling dielectric in a memory cell comprising... forming an oxide on a substrate...forming Ta₂O₅ on the oxide...*oxidizing the Ta₂O₅ with rapid thermal process (RTP)* at a temperature above the crystallization temperature for Ta₂O₅...”. (Emphasis added). The Yoon and the Wurster references do not disclose or fairly suggest this. Although the Chao reference discloses annealing a tantalum oxide layer using RTP, Chao specifically teaches forming tantalum oxide nitride layers adjacent to the tantalum oxide layer to prevent the formation of a silicon oxide layer adjacent to the tantalum oxide layer. Tseng also does not remedy the missing teaching. Claim 1 is therefore allowable. Claims depending from claim 1 are also allowable based upon the allowable form of the base claim and further in view of the additional limitations recited in the dependent claims.

Claim 7, as amended, recites in pertinent part: “A method of forming a coupling capacitor in a memory cell comprising...forming an oxide on a substrate to a depth of about 30 angstroms...*forming a tantalum oxide having a crystallization temperature on the oxide* to a depth of between about 60 angstroms and about 100 angstroms...*oxidizing the tantalum oxide with rapid thermal processing (RTP)* at a temperature above the crystallization temperature of tantalum oxide...”. (Emphasis added). Again the asserted combination of Yoon and Wurster do not disclose or suggest this. Claim 7 is also therefore allowable. Claims depending from claim 7 are also allowable based upon the allowable form of the base claim and further in view of the additional limitations recited in the dependent claims.

Claim 13, as amended, recites in pertinent part: “A method of forming a coupling dielectric in a memory cell comprising...forming a layer of SiO₂ on a substrate...*forming a layer of Ta₂O₅ on the layer of SiO₂...oxidizing the Ta₂O₅ with rapid thermal processing (RTP)...*”. (Emphasis added). As described in more detail above, the asserted combination of Yoon and Wurster fail to disclose or fairly suggest this. Claim 13 is now allowable. Claims depending from claim 13 are also allowable based upon the allowable form of the base claim and further in view of the additional limitations recited in the dependent claims.

Claim 16, as amended, recites in pertinent part: “A method of forming a coupling dielectric in a memory cell, comprising...forming an oxide layer on a substrate...*forming a tantalum oxide layer on the oxide layer...oxidizing the Ta₂O₅ with rapid thermal processing (RTP)...*”. (Emphasis added). The asserted combination of Yoon and Wurster fail to disclose or fairly suggest this. Claim 16 is therefore in allowable form. Claims depending from claim 16 are also allowable based upon the allowable form of the base claim and further in view of the additional limitations recited in the dependent claims.

Claim 19, as amended, recites in pertinent part: “A method of forming a coupling dielectric in a memory cell, comprising...forming a thermally grown oxide layer having a thickness of between about 28 angstroms and about 32 angstroms on a substrate...*forming a tantalum oxide layer on the thermally grown oxide layer...oxidizing the tantalum oxide layer with rapid thermal processing (RTP)...*”. (Emphasis added). The asserted combination of Yoon and Wurster also fail to disclose or fairly suggest this. Claim 19 is therefore in allowable form. Claims depending from claim 19 are also allowable based upon the allowable form of the base claim and further in view of the additional limitations recited in the dependent claims.

Claim 22, as amended, recites in pertinent part: “A method of forming a coupling dielectric in a memory cell, comprising...forming an oxide layer on a substrate...*forming a tantalum oxide layer by metal organic chemical vapor deposition to a thickness of between about 60 angstroms and about 100 angstroms on the oxide layer...oxidizing the tantalum oxide layer with rapid thermal processing (RTP)...*”. (Emphasis added). The Yoon and the Wurster references do not disclose or fairly suggest this. Although Chao reference discloses annealing a tantalum oxide layer using RTP, and further discloses using an organic chemical vapor deposition, Chao specifically teaches forming tantalum oxide nitride layers adjacent to the

tantalum oxide layer to prevent the formation of a silicon oxide layer adjacent to the tantalum oxide layer. Claim 22 is therefore allowable. Claims depending from claim 22 are also allowable based upon the allowable form of the base claim and further in view of the additional limitations recited in the dependent claims.

Claim 25 recites in pertinent part: “A method of forming a coupling dielectric in a memory cell, comprising...forming an oxide layer on a substrate...*forming a layer of a material having a permittivity of between about ten and about twelve on the oxide layer...*”. (Emphasis added). Neither the Yoon reference nor the Wurster reference discloses a permittivity range for a material on the oxide layer. Claim 25 is therefore allowable. Claims depending from claim 25 are also allowable based upon the allowable form of the base claim and further in view of the additional limitations recited in the dependent claims.

Claim 28, as amended, recites in pertinent part: “A method of forming a coupling dielectric in a memory cell, comprising...forming an oxide layer on a substrate...*forming a tantalum oxide layer on the oxide layer...oxidizing the tantalum oxide layer with rapid thermal processing (RTP)...*”. (Emphasis added). The asserted combination of Yoon and Wurster fail to disclose or fairly suggest this. Claim 28 is therefore in allowable form. Claims depending from claim 28 are also allowable based upon the allowable form of the base claim and further in view of the additional limitations recited in the dependent claims.

Finally, claim 31, as amended, recites in pertinent part: “A method of forming a coupling dielectric in a memory cell, comprising...forming a dielectric stack to a thickness of between 140 angstroms and 240 angstroms, wherein forming the dielectric stack includes...forming an oxide layer on a substrate...*forming a tantalum oxide layer on the oxide layer...oxidizing the tantalum oxide layer with rapid thermal processing (RTP)...*”. (Emphasis added). Again, as described in greater detail above, the asserted combination of Yoon and Wurster simply fail to disclose or fairly suggest this. Claim 31 is therefore in allowable form. Claims depending from claim 31 are also allowable based upon the allowable form of the base claim and further in view of the additional limitations recited in the dependent claims.

CONCLUSION

Applicant respectfully submits that the claims are in condition for allowance and notification to that effect is earnestly requested. The Examiner is invited to telephone Applicant's attorney (612) 349-9587 to facilitate prosecution of this application.

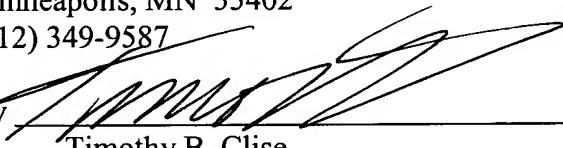
If necessary, please charge any additional fees or credit overpayment to Deposit Account No. 19-0743.

Respectfully submitted,

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CERTIFICATE UNDER 37 CFR 1.8: The undersigned hereby certifies that this correspondence is being deposited with the United States Postal Service with sufficient postage as first class mail, in an envelope addressed to: Mail Stop RCE, Commissioner of Patents, P.O. Box 1450, Alexandria, VA 22313-1450 on this 5 day of December 2006.

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